

**Evaluation of
Farm IPM
Practices in
Alternative Crops
Program**

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Cochabamba

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EXECUTIVE SUMMARY

Twelve farms in the humid, tropical Chapare of Bolivia were visited from 01-10 December 1999 by Plant Pathologist Charles W. Averre and Entomologist Kenneth A. Sorensen, both from North Carolina State University. The purpose was to evaluate actual grower pest management practices and the supportive infrastructure in the IBTA/DAI alternative crops program. They were well received by local personnel and growers. All persons encountered were highly dedicated, motivated, well informed, and professional.

Modern crop production requires a support infrastructure for technical information, identification of production problems, research to solve pest and other problems, and an extension (outreach) program to gather and disseminate information. This is needed in order for growers to reliably deliver quality products at reasonable prices to local and international markets.

Unfortunately, this support structure is not being adequately delivered to growers despite these services being available with personnel, agencies, laboratories, and other resources. For example, of the farms visited none reported having ever had samples taken or reports seen for soil nutrient analyses, tissue samples for nutrient levels, samples for nematode assay. Use of pathogen/pest-free, certified planting material apparently is not available or not being used. The consequences have been dire: for example, the recent outbreak of canker and leaf miner of citrus and the existence of the burrowing nematode in banana. These problems should not be present. They substantially threaten the sustainability of the emerging alternative crops. Other pests in the exterior abound and pose serious threats to these and other crops grown in the Chapare. Every effort should be made by growers to prevent their entry.

RECOMMENDATIONS

- 1- Growers must demand an effective Plant and Seed Certification program.
- 2- Professionals and administrators must participate in international, annual, professional meetings and workshops.
- 3- The Plant Disease and Insect Clinic must be updated with three assistants and updated equipment and supplies. Desperately needed is a current, usable library and Internet resources.
- 4- The use of restricted use pesticides by researchers at La Jota should not be prohibited. They need to be well informed on their uses and limitations. Modern agriculture relies on them.

5- Professionals at La Jota should evaluate all pesticides as a component of IPM in the Chapare. They should be allowed to obtain grants from various sources such as commodity groups, granting agencies, pesticide industry, etc. for their own use with a 10-20% overhead going to administration. They should release annually as a publication a "La Jota Recommendations for Pest Management."

6- Coordination and close working relations with the numerous agencies working in the Chapare should be addressed.

7- Staff at La Jota should have their homes in the Chapare and be a part of the community.

INTRODUCTION

The tropical region in the province of Cochabamba, Bolivia is known as El Chapare. Within the last fifty years it has been settled by natives from the highlands (campesinos) who speak Quechua and still retain their traditional dress. The area was closely linked to Cochabamba by completion of an impressive highway to the Amazonian basin to the east. Following age old customs, the campesinos grow coca for their own use, however, within a few years the area became a major international source for cocaine. The Bolivian government in cooperation with international agencies is trying to develop "Alternative Crops" for export. Income from these crops should lessen the dependency of campesinos on coca export for a cash crop.

Unfortunately, export crops must meet international standards of quality, reliability of product, and price. With few exceptions in the world, this is achieved with a well integrated public and private infrastructure of support for growing, packaging, shipping, and marketing of each commodity. Examples of necessary infrastructure include: roads, power grids, hospitals, schools, quarantines, inspection services, plant certification, cooling and packaging facilities, soil and tissue analyses laboratories, plant disease and insect diagnostic services, field research to evaluate pest management and crop production technology to the unique ecological niche in the Chapare, and outreach programs (extension) to monitor field conditions and disseminate the evaluated technology to producers and produce handlers. In the Chapare, these infrastructure components exist and in many cases are excellent. However, there are gaps that are threatening the sustainability of alternative crops. We were asked to assess Integrated Pest Management (IPM) programs and make recommendations.

ITINERARY (30Nov-11Dec 1999)

Tue 30Nov: Depart Raleigh for Bolivia via Miami.

Wed 01Dec: Fly to Cochabamba, check into Los Portales Hotel, nap, visit library at DAI office.

Thu 02Dec: Drive to Villa Cunari; check into Los Tucanes Hotel ; met Larry Szott, Jot Smith, Russell Yost, and driver Rene Gerra; drive to La Jota; met in director's office Raul Mejia, Dir., Jose (Pepe) Camacho, Dr. Rene Andrews, and MIP extensionists; visit Plant Pathology and Entomology Labs and met phytopathologist Carmen Guzman; return to hotel and met Bob Maloney.

Fri 03Dec: heavy rain; comprehensive discussions with Dr. Rene Andrews and his student from the Univ. Mayor San Simon, Camacho, and Guzman in their laboratories and MIP personnel: Cleto Prado, Gunter Marcus, Omar Merida S., and Fernando Bohorquez U.; examine black pepper planting at La Jota; mass exodus of personnel; depart for Los Portales Hotel in Cochabamba.

Sat 04Dec: breakfast with Dr. Harry McGill, economist DAI; meet with Univ Mayor de San Simon students and Partners: Mauricio Crespo S. of Biosis, Gabriela, Maria, Willie, Nabor, Marcelo, Tanya, Grover, Ackbar, and Alvaro Pozadas.

Sun 05Dec: work on report; visit and tour with Mauricio Crespo S. of Biosis (1986-93 ento. Univ Tecnologico de Monterrey, Mexico.

Some suggestions:

Assess production problems by areas.

Corroborate information so it will be "confiable."

Producers need information "disponabilidad." Information sheets on specific problems. Determine factors that contribute to low yields.

Unidad de Sanidad Vegetal has changed to Servicio Nacional de Sanidad Agropecuaria and has been contracted.

Biosis wants to install automated weather stations in banana farms to forecast Black Sigatoka in the Chapare. They cost about \$13,000 from Adcon Telemetry, Inc of Boca Raton, FL, an Austrian firm established in 1992. It is being used by plant pathologist, Dr. Bernaldo Mora of Dole in Costa Rica.

Mon 06Dec: Drive to Los Tucanes Hotel with Dr. Rui Leite, citrus plant pathologist from Brasil. Drive to La Jota and met Rosario Fuentes, Raul Mejia, and Arturo Quispe and toured La Jota station. Visit pesticide dealer in Chimore and spoke with Leoncio Almandras. He must be licensed and meet three year educational requirements. Visit Nuevo Canaan. Met citrus canker quarantine personnel: Ing.Agr. Victor Hugo Saavedra V of Sanidad Vegetal Prefectura CBBA, and Ing.Agr. Jorge Antesana Tecnico Responsable FAO. The citrus canker outbreak involves over 50 producers and nurseries. Visit citrus farm of Nicolas Tercero.

Tue 07Dec: Visit farms with Arturo Quispe.

Wed 08Dec: Visit farms with Jose Camacho, Rene, Cleto, Gunter, and Fernando, conference with Daniel Sanchez on citrus canker. Met Ing. Trifon Ayauri of Fabopal cannery.

Thu 09Dec: Breakfast with Dr. George Wilson, Dr. Larry Nelson, Bob Maloney, Dr.

Richard Beck (Geo.Univ Cin), Dr. Richard Fisher, Dr Rui Leite, Dr. Frank Smith (Psych Dept NCSU). Dr. Rui Leite spoke to La Jota staff on citrus canker. Max Rojas is on the Programa de Desarrollo Alternativo Regional (PDAR). Visit Sacra with Rene Andrews and his student Barrientos Antezana Darwin, Gunter, Ramiro, and Fernando.

Fri 10Dec99: Oral presentation to La Jota staff. Visit with Trifon Ayaviri of Fabopal cannery, soil analysis costs \$17.00 for IBTA and \$19.00 in CIAT in St. Cruz. Return to Cochabamba Los Portales Hotel.

Sat 11Dec99: Depart Cochabamba. Arrive Raleigh 9:15pm.

METHODOLOGY AND COMMENTS

Farms visited were selected by persons at La Jota and this probably introduced a bias in our observations. We had developed two forms with sufficient copies to be used at each site in order to gather information in a systematic manner. (See Appendix). The first form "Farm Visit Form" was to record location, basic farm information, farming system, living condition, etc. The second form, "IPM Assessment," was used to record various pest management practices and available resources.

At each site we recorded GPS positions, elevation, crops grown, crop problems, size of planting, soil type, topography, general problems, comments of the grower and others in the group. The interview process to gather and record the above information was tedious and at time frustrating. In every case the grower was patient and very helpful. Recording errors and omissions in data was noted later. At each site we walked to each planting and observed pests and other problems. Gathering data was complicated by the fact that most farms had four or more crops and it was difficult to profile each.

CROPS EVALUATED AND COMMENTS

With some exceptions, crops looked very good and healthy. In part this may be due to the newness of plantings and to the practice of intercropping and small, scattered plantings. Aside from clearing the land, establishing the crop, cutting weeds, the general impression is that inputs such as use of fertilizers and pesticides is minimal. Much of the products appear to be basically "organic" in nature. Personnel at La Jota are well informed on diseases, insect and other problems in all of the crops observed. Where pesticides were used, application was made by hand pump backpack sprayers. A few used motorized versions. Aerial application was observed on some banana plantations. Problems with pesticide safety, storage, application, and container disposal need addressing.

BANANA Many bananas were grown in large (10-20 ha blocks) commercial fields that appeared to conform to practices of the large banana companies in Central America in terms of growing, packaging, and shipping of the fruit. Fruit quality appears excellent in the farm. Fruit damage by thrips was minor, however, scarring by coleoptera beetles in one farm involved 30% of the hands. Growers complain of Black Sigatoka, a leaf spot that requires considerable use of fungicide sprays and sanitation to remove infected leaf tissue. Poor nutrition, drought, chilling winds from the south, and financial credit were also mentioned as problems. Possibly the most serious problem is the presence of the burrowing nematode. This is a "seed-borne" disease and should not be in a plantation.

CITRUS Citrus included oranges, tangerines, and sweet lemons were usually grown in small parcels. Often one or two trees for home use. Problems with this

crop are numerous and serious. They include poor nutrition, scab (*Elsinoe* fungus) on the fruit, leaf miners, white fly, and scale. White flies, scales, and mite problems appeared to be well managed in several cases. Presence of leaf miners (*Lepidoptera*) was serious in a citrus nursery and recent planting. A new problem is the introduction of Citrus Canker, a bacterial leaf spot, that causes defoliation and reduction in quality. These two major problems need immediate and long term attention. The presence of this disease is grave. Quarantines will probably be imposed and restrict sale of fruit in international and other markets. It is a "seed-borne" disease and should not be present. The presence of these recently introduced problems should be a "wake up call" for agricultural producers and interests in Bolivia and especially in the Chapare.

MARACUYA Maracuya (passionfruit) is grown on vines in small parcels of less than 1/2 ha. *Fusarium* wilt, *Cladosporium* fruit rot (verugosis), and leafhoppers were observed frequently. Growers complained of *Rhizoctonia* foliar blight. A "new" *Pyralid* moth injury to fruit and stems was observed in several plantings. A student is conducting a thesis on this problem. Some of these problems will probably intensify with time.

PALMITO Palmito (palm hearts) are grown in relatively small parcels of 1-2 ha and appear to be doing very well. The quality of product appears excellent and several canneries are in the area and are interested in export markets. We tried a canned sample from Fabopal with Trifon Ayaviri A., it was excellent. The product would probably qualify as "organic" in U.S. markets. Weevil injuries to the product was observed and mentioned as a major problem. Research on the biology and control of the weevil are underway. Fierce ants nesting at the base of the palm trees were also mentioned. MIP personnel mentioned nutritional problems and poor root development as a result selecting heavy, wet soils with high aluminum content for the planting.

PAPAYA Papaya planting were usually in small parcels. Tree growth appeared excellent and virus mosaic symptoms were not observed as is the case in most papaya growing areas. Fruit rot, anthracnose, lack of female flowers, and others were mentioned as problems. Some mealybugs and scale were observed. However Mediterranean fruit fly has been reported in the Chapare at low levels and presents a constant threat to fruit production and movement of product.

PIMIENTA NEGRA Black pepper vines was grown on posts or tree trunks and appeared to be growing well. Growers complained of drought, anthracnose, and leafhopper problems. Ants in association with mealybugs were observed in several plantings. Curculionid adults were seen cutting foliage in all plantings. A

major problem in black pepper plantations is Fusarium Wilt and was seen in every planting and probably will limit the productive life of plantings. This is probably a seed-borne disease which should not be present.

Piña Pineapple is grown on relatively large blocks of 2-3 ha and quality appears excellent. Sunburn and rots were mentioned as causing losses in the order of 50%. The sunburning may be the result of the extended drought a few months ago. Mealybugs and a Lepidopterous borer were reported as causing fruit injury as was damage caused by rats, monkeys and other animals. Growers also mentioned that nutrition, theft, and lack of transportation to markets during rainy periods were problems.

YUCA Yuca or cassava is of exceptional quality and no problems were observed or mentioned. A threat to this crop is the introduction of virus and other diseases.

OTHER CROPS Small parcels, occasional plants, and mixed planting of the following crops were observed and some had recognizable problems: rice (*Piricularia* blast), corn (*Helminthosporium* leaf spots), coca, achiote (*Bixa* sp). Interestingly, beans (*Phaseolus* sp) were not seen and were not served for meals.

EVALUATION OF THE PLANT CLINIC

The presence of an identifiable Plant Clinic in the Chapare is excellent and is a basic resource for the sustainability of the Alternative Crops Program. It is staffed by a competent and dedicated entomologist and two plant pathologists. Unfortunately the physical facility is in poor condition and probably inadequate for the task expected. Desperately needed is a system and facilities to handle specimens that MIP Extension personnel bring in for identification. There needs to be "dirty room" to serve as a receiving room for specimens for initial examination by the entomologist and plant pathologists. The receiving room should have a large table, a sink with a soil trap, racks for extracting nematodes, shelving for moist chambers, and a large refrigerator to hold specimens. A receptionist who also handles the clerical work of the Plant Clinic should also be provided.

An integral part of a Plant Clinic is a soil and tissue analysis laboratory. However, this resource need not be located at La Jota as samples could be handled by a single, well equipped IBTA laboratory elsewhere, e.g. in Santa Cruz.

A communications system for linkages via the Internet with other Plant Clinics is necessary and is in place with most Plant Clinics in other areas. This resource is needed with equipment so that images of pathogens, insect, host symptoms, etc can be sent and received to other plant clinics, world-wide. This system will not take the place of an entomologist or plant pathologist, however it will greatly enhance their ability to serve the local agricultural community.

A secure and separate building or room is needed to store and handle pesticides. This facility needs to be equipped with electricity, lighting, water, a sink, working table, measuring equipment, and exhaust hood. Safety equipment should include containment enclosure, emergency shower, fire alarm and extinguishers. A policy for regular inspections, storage, handling, and disposal of pesticides need to be developed and implemented.

Plant Pathology: Much of the equipment in the plant pathology laboratory is in poor condition and in need of repair, upgrading, or replacing. A partial list of equipment has been prepared in the Appendix. A technical assistant to perform routine tasks in the laboratory is urgently needed to free the pathologists to spend more time in research and problem solving. An up to date working library with CD video is also needed. Some references have been ordered and should be in place at this time. See list in the Appendix.

Entomology: Much of the equipment in the entomology laboratory is in poor condition and in need of repair, upgrading, or replacing. An insect rearing and

biological control rooms are badly needed. An up to date working library with CD video is also needed. Some references have been ordered and should be in place at this time. See list in the Appendix.

EVALUATION OF THE AGRICULTURAL INFRASTRUCTURE IN THE CHAPARE

Noteworthy in the Chapare is the presence of all facets of infrastructure to support a modern, competitive, agricultural industry. This includes: roads, municipal water, telephone service, electricity, agricultural research facility, extension service, soil and tissue analysis clinics, plant and seed certification programs, plant quarantine inspectors, and above all competent, dedicated and enthusiastic personnel. The problem is that for several reasons some of the services are not working too well and producers do not receive them (see Table 1. Summary of farm observations.)

Personnel, resources, and complementary agencies in the Chapare need to be identified and specific objectives and goals of each described and shared. This would facilitate greater understanding and use of resources to serve the agricultural community.

RECOMMENDATIONS

1) Growers must demand an effective Plant and Seed Certification Program. This is largely an education challenge for IBTA and DAI. The absence of reliable, pest-free, certified planting stocks and grower on-farm seed production system is an enormous burden on producers. This is especially true when new plantations are established. Use of contaminated planting material condemns the producer for the life of the plantation to costly, and usually only partially effective management practices. Not infrequently pests may threaten the economic viability of the crop and sustainability of alternative crops. In some cases the presence of certain pests (e.g. citrus canker) excludes many important market outlets due to imposed quarantines. In some cases other commodities from infested areas and non-infested areas may also be placed under quarantine. Tragic examples of the consequences of the use of contaminated planting material abound: coffee rust in Brasil and in Bolivia the burrowing nematode of banana in the Chapare, white rot of onion in the highlands, and canker of citrus also in the Chapare. There is probably no more cost effective IPM tactic than the effort made to maintain a seed and plant Certification Program.

2) Professionals and administrators must participate in international, annual, professional meetings and workshops. They are the most valuable "commodity" and need constant attention in order for them to carry out their missions effectively. Technology in crop production and marketing is in a constant flux of change and opportunities. Producers and consultants continue to improve in their knowledge base and expertise in crop production. If the staff is not constantly undergoing training and updating, they lose the confidence of the agricultural community. We want to point out that on a visit to a palmito farm, the owner was participating in a palmito conference workshop in Costa Rica while his wife tended to the farm.

3) The Plant Disease and Insect Clinic must be updated with three assistants and updated equipment and supplies. Desperately needed is a current, usable library and Internet resources.

4) The use of Restricted Use Pesticides by researchers at La Jota should not be prohibited. Modern agriculture relies on their use in some critical facets in the long chain steps involved in crop production and contribute substantially to the sustainability of cropping enterprises. Apparently growers in the Chapare use some of them and probably wonder why the staff does not mention them. Researchers at La Jota need to evaluate them in order to understand their strengths and limitations. Recommending widespread use of restricted use pesticides to growers is another issue.

5) Professionals at La Jota should be allowed to obtain grants for their own use with a 10-20% overhead going to administration. The effectiveness of the staff and the station as a valuable asset to the community would be enhanced by

close cooperation with outside groups that could provide funds, expertise, contacts, and resources. Usually however, outside groups like to work with individual who have control over their resources. For example, a seed company may want a new variety evaluated under conditions in the Chapare and would be willing to provide cash, seed, planters, expertise, etc. to a staff member with whom they have established a good working relationship. Often prospective grantors are reluctant to give resources to institutions if the staff member does not have control of them. The staff member would be responsible for the resources and for implementing the evaluation under the terms of a Memorandum of Agreement of La Jota between the seedsman and the staff member. The staff member would have free access to the new resources and be individually responsible for the work. This system of grants has proven to be highly successful in many areas. There is of course a possibility of limited abuse and guidelines must be developed.

6) Coordination and close working relations with the numerous agencies working in the Chapare should be addressed. It appears that there is a plethora of national, international, and private groups and individuals working in the area. Somehow their activities should be coordinated in order to enhance a coherent and stable service infrastructure to for producers and shippers.

7) Staff at La Jota should have their residences and homes in the Chapare and be a part of the community. We wonder what message is being sent to the Chapare citizens and producers for the station to maintain peculiar operating schedules to accommodate the staff in their desire to live in a far away sophisticated city.

8) Training workshops for consideration:

a) Staff and administrative personnel development.

b) Entomologist should attend the International Congress of Entomology in Brasil in August 2000.

c) Use of insect taxonomic keys, scientific terminology, field kits, library, field demonstrations and tests, and plant clinics with electronic resources.

d) Methods on sampling for insect and disease levels, economic thresholds, field plot design, analysis of test results, reporting results, and publishing reports in regional and international outlets and journals.

e) Diagnosing plant diseases caused by virus by use of viral inclusion bodies. One week workshop at University of Florida in Gainesville.

f) Diagnosing plant diseases caused by nematodes. A two week workshop at Clemson University, South Carolina.

- g) One month internships in a well established Plant Disease and Insect Clinic such as those located with the University of Kentucky, University of Florida at Gainesville and Homestead, North Carolina State University, and others.
- 9) Research/investigation. IPM investigations and pesticide evaluation studies need to be established at the La Jota station and with on-farm test demonstrations. Other research and latest technology, i.e. (*Bacillus thuringiensis* sweet corn seed was provided) should be conducted proactively.
- a) Banana fruit coleoptera injury: insect species involved and population dynamics (a possible student thesis).
 - b) Mediterranean Fruit Fly area wide monitoring system needs to be established. This is needed to establish control tactics and for export of fruit.
 - c) On maracuya, the biology and management of Hemiptera spp. And Pyralid moth.
 - d) On black pepper, thresholds on curculionid insects need to be established.
 - e) On citrus, economic assessment, biology, and management of leaf miner.
 - f) Disease Management: banana - burrowing nematode, maracuya and pimienta negra - Fusarium wilt, pineapple - fruit and stem rot.
- 10) Publications needed:
- a) Crop Profiles on the major crops should be prepared immediately (see format in appendix). These can be used by growers, other agencies, and decision makers.
 - b) An annual publication on pesticides evaluated and recommended by La Jota scientists is critical to support MIP extension work. The publication would list the pesticides alphabetically by crop and give rate, schedule, methods of application, and precautionary information.

ACKNOWLEDGEMENTS

We wish to thank the staff of the International Office of CALS and N.C. State University, DAI, and La Jota for facilitating this trip and for the many courtesies extended.

Table 1. Summary of farm observations

Number of farms visited: 12

Elevation: 260-430m (853-1418ft)

Farm size: 6-25ha, mean=18.2ha (15-62A, mean=45A)

Slope: Most were basically level with a possible 1% slope to the NNE.

Occasional draws.

Structures: Except for two farms, all had one classical farm house on elevated pilings that permitted considerable work and storage space under the living quarters. There were no partitions. There was no evidence of screens.

Three farms had buildings for handling and packaging bananas and other commodities such as pineapple.

Equipment: 5 farms had none; 2 hired aircraft for spraying; 2 had tractors; 1 had a weed eater, 2 had a motorized backpack sprayer; 2 had a chain saw.

Electricity: 5 farms had none; 1 farm had solar; 3 had single phase; 2 farms had triphasic.

Water: 4 farms had municipal water.

Schools: All farms had access to grade and high schools.

Livestock: Except for a few chickens and pigs none had livestock.

Reside on farm: 6 yes, 4 no.

Soil type: Much of it looked like a heavy loam to clay described as "arenoso, arcilloso."

Irrigation: None could irrigate. One was considering installing a system to irrigate his citrus nursery.

Drainage: The top soil of some 1-2m thick is over gravel in many cases. All farms relied on natural drainage.

Labor: 5 farms relied on immediate family. 5 farms hired additional help.

Kept records of farm events: 3 farms.

Samples taken for soil fertility: no farms.

Samples taken for tissue analyzes: 1 farm.

Samples taken for nematode assay: 1 farm.

Samples taken for disease diagnosis: 12 farms.

Samples taken for insect identification: 12 farms.

Sources of IPM (MIP) information: (Number of farms)

| | | |
|-------------------|---------------------|------------------|
| TV = none | Radio = 2 | Extension = 12 |
| Tour = 7 | Pesticide sales = 5 | Publications = 8 |
| Grower assoc. = 7 | | |

Table 2. Sites visited, GPS coordinates, elevation, and bearing and distance to La Jota station

| Location | Coordinates | | Elevation | Bearing to La Jota |
|----------------------------------|-------------|-------------|-----------|--------------------|
| | South | West | | |
| La Paz airport | --o -- | --o -- | 3400 m | -- |
| Cochabamba near DAI on bridge | 17o 22.74' | 066o 09.15' | 3160 m | -- |
| Pass to Chapare | 17o 24.08' | 065o 52.51' | 3540 m | -- |
| Los Tucanes hotel | 16o 58.21' | 065o 23.81' | 420 m | -- |
| La Jota | 16o 59.79' | 065o 10.23' | | |
| Nuevo Canaan | 16o 57.50' | 065o 07.94' | -- | 5.6mi 229o |
| Victor Tercero | 16o 56.31' | 065o 17.31' | -- | 8.7mi 122o |
| Mariposa | 17o 00.64' | 065o 02.32' | -- | 8.8mi 282o |
| Sacra | 17o 07.06' | 064o 49.93' | -- | 29.3mi 293o |
| Farm 1, M.Romero | 16o 54.71' | 065o 09.26' | -- | 5.9mi 195o |
| Farm 2, Los Cormos | 16o 59.62' | 065o 10.82' | -- | -- |
| Farm 3, Papa Juan | 16o 58.93' | 065o 10.88' | -- | 1.2mi 148o |
| Farm 4, O. Sabala | 16o 56.36' | 065o 22.85' | 430 m | -- |
| Farm 5, A. Sambrana | 16o 59.73' | 065o 10.85' | -- | 0.7mi 198o |
| Farm 6, Curichal | 16o 59.45' | 065o 05.63' | 280 m | 5.7mi 272o |
| Farm 7, M. Alban | 16o 59.60' | 065o 02.93' | 400 m | 8.0mi -- |
| Farm 8, L. Choque | 16o 59.60' | 065o 08.70' | 280 m | 1.7mi 270o |
| Farm 9, B. Salvatie | 16o 58.62' | 064o 56.98' | 320 m | 14.6mi 006o |
| Farm10, C. Mamani | 17o 13.13' | 064o 50.76' | 260 m | 26.4mi 311o |
| Farm11, F. Inojosa | 17o 12.61' | 064o 42.13' | 350 m | 34.2mi 301o |
| Farm12, M. Rojas | 17o 14.91' | 064o 41.62' | 400 m | 36.0mi 305o |

CALENDAR OF ACITIVITIES (30Nov-11Dec 1999)

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Sun 05Dec: Election day with no movement of vehicles; laundry; work on report; visit and tour with Mauricio Crespo S. of Biosis (1986-93 ento. Univ Tecnologico de Monterrey, Mexico

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Biosis (Mauricio Crespo S., entomologist, consultant, Biosis Soc. Res. Limitada

Agricultura y Agronegocios, biosis@bo.net, Av. Junin No. 347, FAX 04-286882 Cochabamba, Bolivia) wants to install automated weather stations in banana farms to forecast Black Sigatoka in the Chapare. They cost about \$13,000 from Adcon Telemetry, Inc of Boca Raton, FL, an Austrian firm established in 1992. It is being used by plant pathologist, Dr.

Bernaldo Mora of Dole in Costa Rica.

Mon 06Dec: Drive to Los Tucanes hotel with Dr. Rui Leite, Citrus Plant Pathologist from Brasil. Drive to La Jota and met Rosario Fuentes, Raul Mejia, and Arturo Quispe and toured La Jota station. Visit pesticide dealer in Chimore and spoke with Leoncio Almandras. He must be licensed and meet three year educational requirements. Visit Nuevo Canaan. Met citrus canker quarantine personnel: Ing.Agr. Victor Hugo Saavedra V of Sanidad Vegetal Prefectura CBBA, and Ing.Agr. Jorge Antesana Tecnico Responsable FAO. The citrus canker outbreak involves over 50 producers and nurseries. Visit citrus farm of Nicolas Tercero.

Tue 07Dec: Visit farms with Arturo Quispe.

Wed 08Dec: Visit farms with Jose Camacho, Rene, Cleto, Gunter, and Fernando, conference with Daniel Sanchez on citrus canker. Met Ing. Trifon Ayauri of Fabopal cannery.

Thu 09Dec: Breakfast with Dr. George Wilson, Dr. Larry Nelson, Bob Maloney, Dr. Richard Beck (Geo.Univ Cin), Dr. Richard Fisher, Dr Rui Leite, Dr. Frank Smith (Psych Dept NCSU). Dr. Rui Leite spoke to La Jota staff on citrus canker. Max Rojas is on the Programa de Desarrollo Alternativo Regional (PDAR). Visit Sacta with Rene Andrews and his student Barrientos Antezana Darwin, Gunter, Ramiro, and Fernando.

Fri 10Dec99: Oral presentation to La Jota staff. Visit with Trifon Ayaviri of Fabopal cannery, soil analysis costs \$17.00 for IBTA and \$19.00 in CIAT in St. Cruz. Return to Cochabamba Los Portales hotel. Farewell fiesta at Las Americas with Partners of the Americas.

Sat 11Dec99: Depart Cochabamba at 7am for Santa Cruz for 10:30 flight to Miami. Arrive Raleigh 9:15pm.

FARM VISIT FORM

Name of farm_____ Date_____ Code_____

Location_____ Time: in_____ out_____

Direccion _____ GPS _____

Elev:_____ Size of farm_____ Slope_____

Structures_____

Equipment_____

Electricity and type_____ Water_____

Persons on Farm_____ School_____

Livestock_____

Observers_____

| Crop | Size | Problems/comments |
|------|------|-------------------|
|------|------|-------------------|

| | | |
|-------|-------|-------|
| _____ | _____ | _____ |
| _____ | _____ | _____ |
| _____ | _____ | _____ |
| _____ | _____ | _____ |
| _____ | _____ | _____ |
| _____ | _____ | _____ |

IPM ASSESSMENT

Name of farm_____ Date_____ Code_____

Crop:_____ Size_____

Planted_____

Previous crop_____

Adjacent fields_____

Harvests_____

Soil type_____

Drainage/(irrigation)_____

Pest problems_____

Pesticides/dates_____

Applicator_____ Safety_____

Sources of Information (circle):

| | | | |
|------|----------|-----------|-------------|
| TV | Radio | Extension | Meeting |
| Tour | Neighbor | Dealer | Publication |

Scouting_____

Records_____

Market_____

Soil sample_____ Tissue analysis_____ Insect ID_____

Nema assay_____ Disease ID_____

Assistance needed_____

Pesticides available_____

LIST OF PLANT PATHOLOGY RESOURCES NEEDED

For growers to manage plant diseases in order to reliably deliver

quality products at reasonable prices and have a sustainable

enterprise, a Plant Disease and Insect Clinic is essential. Diseases for every crop must be identified, routinely diagnosed, and in cooperation with growers and others control measures worked out and made available to all producers. The following have been identified:

LIBRARY:

- Postharvest Diseases of Vegetable and Fruit. A. Snowdown.
- Banana Diseases. H. Stover.
- Diseases of Field Crops.
- Diseases of Vegetable Crops.
- Host Index. Farr.
- Identification of Plant Pathogenic Bacteria. N. Schaad.
- Diseases of Minor Tropical Plants. Cook.
- Methods for Evaluating Fungicides and Nematicides.
- Agricultural Chemicals. Meister Publication.
- Plant Disease, monthly journal. APS.
- Brazilian Plant Pathology journal.
- Control of Plant Diseases Organically.

LABORATORY:

- A "Dirty Laboratory" adjacent to the clean laboratory for receipt and initial examination of specimens. This laboratory need not be air conditioned but should be well ventilated with exhaust fans. This laboratory would contain:

- A large sink with a soil trap for washing roots and other

tissues. Waste water and plant trash from specimens received would be disposed of in such a way as to minimize the danger of introducing exotic

plant pathogens to La Jota and adjacent areas.

- A large refrigerator for short term storage of specimens.

- A large centrifuge for extraction of nematodes.
 - Racks for holding Baermann Funnels for extraction of nematodes from soil and tissue.
 - A mist chamber for extraction of nematodes from plant tissue.
 - A desk or table for filling out forms and reports.
 - A large table for examining specimens.
 - Built in shelves to house reference material, placement of moist chambers for incubating specimens, and glassware used in nematodes extractions and examination of specimens.
 - Drawers for storage of tools and supplies used in the preliminary examination of specimens.
-
- Fire extinguisher for each laboratory.
 - First aid kit.
-
- Eye wash station by each sink.
-
- Three small incubators to establish cardinal temperatures for plant pathogens.
-
- Exhaust hood.
 - Microtome for preparing thin microscopic sections of infected plant tissue for examination under the microscope at high magnifications.
 - A digital camera for the high quality microscope with facility to project onto a TV screen and transmission of images over the Internet.
 - A hand held digital camera to take pictures in color for both laboratory and field use.
 - Computer and computer terminal for accessing the Internet to transmit and receive color photographs as well as dialogue with other clinics.

FIELD EQUIPMENT FOR DIAGNOSING AND EVALUATION OF CONTROL TACTICS

- GPS for locating all field tests and disease occurrence.
- Radio communications with La Jota (e.g. cellular telephone).
- Compass with clinometer to accurately orient field tests, plots, and describe slope of the terrain.
- SLR 35-mm camera with flash, tripod, close up lenses, and carrying case.
- A small tool box to house a field kit. The field kit should contain:
 - first aid kit.
 - hand trowel.
 - large knife.
 - hand tools (pliers, screwdriver, etc).
 - bags and other packaging supplies.
 - labels, string, and tags.
 - counter.
 - soil sampling tool.
 - vials.
 - alcohol.
 - soft pencil.
 - waterproof paper.
- Soil injector for placing fumigants in small plots.
- 3 backpack motorized sprayers for applying products to field test and plots.
- 2 backpack manual sprayers for applying herbicides and products to tests.

LIST OF ENTOMOLOGICAL RESOURCES NEEDED

LIBROS & PUBLICACIONES RECOMENDADOS PARA EL IBTA/MIP/CHAPARE

Farm Chemicals Handbook 1998 + CD ROM Electronic Pesticide Dictionary
- \$138.95.

The AgroChemicals Handbook, Royal Society of Chemistry, latest
edition, edited by Hamish Kidd and David R.James.

Crop Protection Chemicals Reference, 1998 edition, John Wiley & Sons.

The Pesticide Manual, A World Compendium, The British Crop Protection
Council, latest edition - \$175.00.

Codex Alimentarius, F.O.A., 2-B, Residuos de Plaguicidas.

1997 Directory of Least Toxic Pest Control Products.

Compendium of Tropical Plant Diseases, The American Phytopathological
Society.

Compendium of Citrus Diseases, The American Phytopathological Society.

Biological and Cultural Tests for the Control of Plant Diseases. The
American Phytopathological Society.

Ilustracion general de hongos perfectos e imperfectos.

Medios de cultivo para bacterias y características de desarrollo.

I.P.M. in Agriculture video - \$95.00.

Pests of the Garden and Small Farm: A Growers Guide to Using Less
Pesticide. M. Flint - \$30.00.

Agricultural Insect Pests of Temperate Regions and their Control. D.
Hill 1987 - \$149.95.

The Gardener's Guide to Common-Sense Pest Control. W. Olkowski...
1995 - \$19.95.

EQUIPMENT AND SUPPLIES:

Field Kit:

Pruning Shears

Knife

Clinic Forms

Vials

Alcohol

Trowel

Compass

Thermometer - Maximum / Minimum

Soil Thermometer

Soil Sampling Tool

Sling Psychrometer for Relative Humidity

Plastic Bags

Insect Sweep Net

Camera, Single Lens Reflex with

Closeup and Microscope Attachment - \$800.00

Digital Camera, Sony - \$500.00

Motorized Sprayer: 3 @ \$500.00/ea. = \$1,500.00

References

Software for Computer on Statistics, etc.

Clipboard

Small Shovel

ENTOMOLOGY LABORATORY MATERIALS

Protective masks with filters and replacements:

2 large filters

2 medium filters

2 small filters

Binocular stereomicroscope with video and camera incorporated.

Flourescent ring microscope.

Nicholas illuminator

Flourescent illuminator with base.

Illumination system.

Replacement bulbs for ring illuminator.

Replacement bulbs for Nicholas illuminator.

Replacement bulbs with base.

Slide viewer.

Timer.

Bibliographic material, taxonomic keys, biology and control of humid tropical pests